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Making Whey Butter at Cheddar Cheese Factories

J. L. SAMMIS

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WHEY BUTTER IN TUBS

About 125 pounds of whey butter can be made each week at a cheese factory of medium size.

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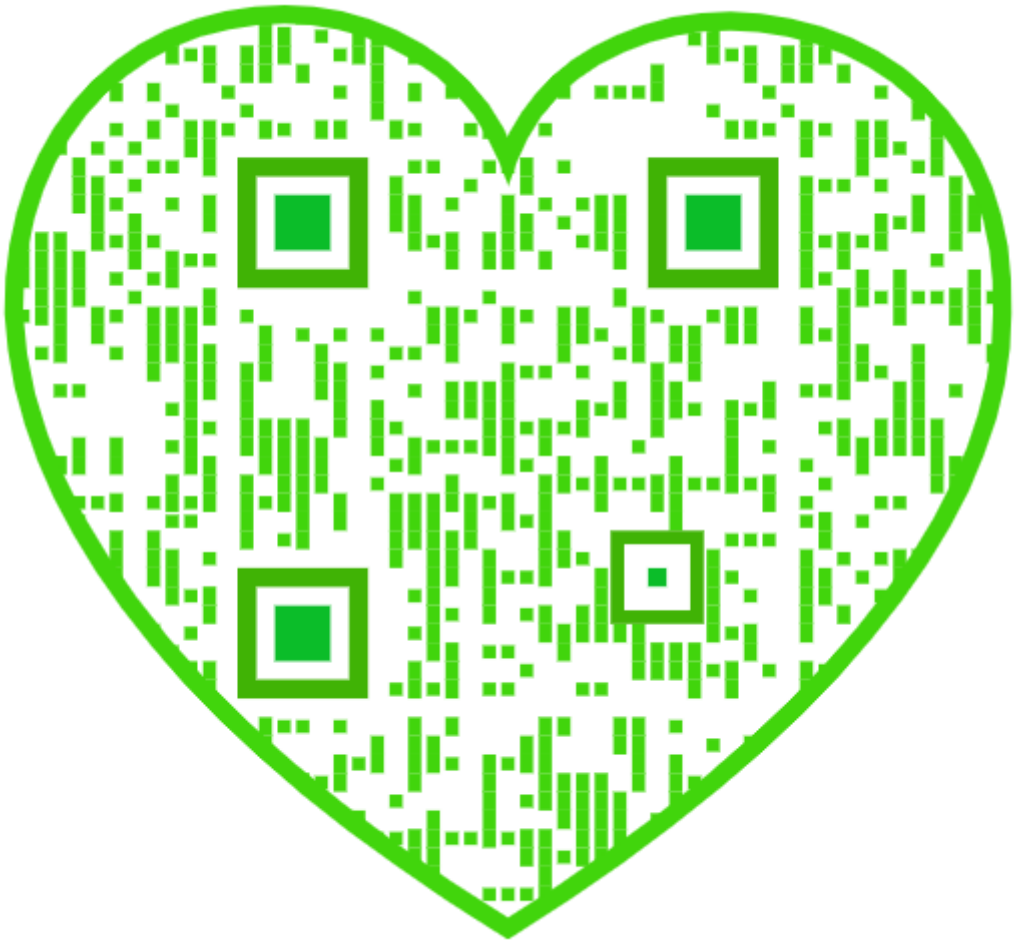

DIGEST

The recovery and utilization of factory wastes of all sorts are now more carefully provided for than ever before. The skimming of whey and the churning of whey cream, long practiced at foreign cheese factories, have been widely adopted by American cheesemakers during the past four years. As an aid to farmers and factory men who are planning to install this process, the present bulletin describes in detail the sources of income, expense, and profit, and various practical methods of conducting the business. Page 3

Before purchasing the necessary equipment for separating whey, it is desirable that the plan and the possibility of increased profit through whey skimming be fully explained to the patrons, so that they will favor the enterprise and will not object to feeding skimmed whey to their live stock. A series of questions and answers gives much of the information needed. Pages 4–8

One or more satisfactory markets should be found where the product, whey butter or whey cream, can be sold. It is desirable to figure as closely as possible in advance the weight of the fat which can be recovered from the whey, and the income derived from its sale at average prices; also the cost of the equipment for skimming or for skimming and churning; and the annual expenses for labor, supplies, repairs, interest, and similar items. Complete lists and prices are given. Pages 8–15

Satisfactory agreements should be made with the machinery supply house, with the prospective buyer of the product, with the cheesemaker who does the work, and with the factory patrons as to the prices or the basis of payments to be made in each case. Pages 15–18

Estimates based on the experience of different factories show that the cost of equipping a factory is proportionately less for the larger sizes than for the smaller, and accordingly whey skimming can become more profitable at the larger factories, although usually not unprofitable at those of smaller size. Pages 18–19

The quality and value of whey cream are largely determined by the sanitary conditions of milk-production, and the care given the whey cream after separating. Whey cream should contain 50 or 60 per cent of fat. It should be skimmed early, cooled quickly, churned promptly with from 75 to 100 per cent of good starter, and kept at a low temperature throughout to insure the best results. Pages 19–22

Churning is not so profitable as separating whey cream. The market value of the fat in whey is about doubled by use of the separator, but the churning of whey cream increases its value only about one-fifth or one-sixth. Churning requires extra equipment and supplies including ice, and some skill and experience in buttermaking. Like whey skimming, the churning process becomes more profitable in proportion to the amount of milk handled at the factory. Therefore, the smaller factories usually prefer not to churn whey cream but to sell it to a central churning station, or to a regular creamery or an ice cream factory. The larger factories prefer to churn more whey cream than they alone can produce, and therefore, usually buy whey cream from neighboring cheese factories. Pages 22–23

Cheese factory patrons and cheesemakers should thoroughly acquaint themselves with the advantages which whey skimming offers, and should study their local conditions to determine whether this enterprise can be profitably undertaken at each factory.

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J. L. SAMMIS

Profit From By-Products

In many large manufacturing plants, efforts directed toward the prevention of waste, and the utilization of by-products have added materially to the income and profits of the business.

In the making of Swiss[1] cheese, the losses of fat in the whey are especially large. It has long been the practice at these factories, wherever located, to skim the whey, formerly by hand, later by milk separators, and more recently by the use of the whey separator[2], and to churn the whey cream into whey butter.

As early as 1908[3], the manufacture of whey butter at cheddar factories had made substantial progress in New York. In 1910, the report was published[4] of a year's work in the skimming of whey and the making of whey butter at an American cheese factory near Plymouth, Wisconsin, showing that about $1,000 was paid to the farmers as their share of the profits. In 1911, there were three factories engaged in this industry in the same neighborhood. In 1912, other factories were reported in New York; and 24 factories skimming whey in Sheboygan County, Wiscon-

[1] E. H. Farrington, The Manufacture of Whey Butter at Swiss Cheese Factories. Wis. Agr. Expt. Sta., Bull. 132, pp. 3–32, **1905.**

[2] The centrifugal whey separator is especially made so that it will skim close and at the same time produce a very rich cream, as free from whey as possible. To make whey butter of good flavor, it is desirable to separate cream containing at least 50 per cent fat, so that from 75–100 per cent of starter can be added before churning.

[3] See also Wing, H. H., Whey Butter N. Y. (Cornell) Sta., Bull. 85, pp. 37–41, **1895.**

[4] Doane, C. F., Whey Butter. U. S. Dept. Agr. B. A. I. Cir. 161, pp. 1–7, **1910.**

sin, were studied under the direction of this Station by John J. Osterhous, at that time a senior student in the College of Agriculture of the University of Wisconsin. Some of the facts thus collected are used in the following discussion. In 1913 and 1914, correspondence with factory men showed that the whey butter industry had spread to numerous factories in many other leading cheese-making counties in the state, and it is still on the increase.

The present bulletin is intended to point out the sources of income and of expense in the whey butter business, and the conditions under which skimming or churning can be undertaken with profit at the cheese factory.

An effort has been made to present the subject with fairness to the cheesemaker and factory patron, so that the costs and running expenses may not be underestimated by factory men who are planning to install a separator, and so that the income and profits from whey separation may not appear larger than the facts warrant. In many cases, the profits may be found somewhat larger than here shown, and by skillful management the expenses may be slightly reduced.

While the facts presented relate more directly to American Cheddar cheese factories the discussion should be of value also to owners or patrons of Swiss, brick, or Limburger cheese factories where the percentage of fat in the whey often exceeds that at American factories.

IMPORTANT MATTERS TO CONSIDER

Either the cheesemaker or the patrons may manage the enterprise and own the machinery. Before money is invested in machinery for skimming or churning whey cream, it is essential (1) that the proposition be explained to all of the factory patrons, so that they will understand that the skimming of whey will be profitable both for them, and for the cheesemaker, and so that they will be willing to feed the skimmed whey to hogs; (2) a near-by market must be looked for, in which the whey butter, or preferably the whey cream, can be sold to good advantage; (3) that as close an estimate as possible be made in advance as to what under the local conditions the gross income, expenses, and net profits from the enterprise are likely to be; and (4) to decide upon methods of conducting the business.

WHY PATRONS SHOULD FAVOR WHEY SKIMMING

The following questions and answers will be found helpful in explaining to factory patrons the advantages of whey skimming:

What is whey fat? When milk is made into American cheese, about nine-tenths of the fat in the milk is retained in the cheese; the rest goes into the whey and drippings from the curd. Whey fat is therefore good butter fat which can be either (1), separated from the whey, churned and sold as whey butter, at from 20 to 30 cents a pound; or (2), can be converted into pork, which sells at eight cents, or less, per pound live weight. In the latter case a part of the fat is commonly left in the whey tank at the cheese factory, and is either used by the cheesemaker for soap grease or is run into the drain when the tank is scrubbed.

How much fat is there in the whey at American cheesefactories? Enough to make from about 10 to 20 pounds of butter a year for each good cow contributing to the factory. The whey from 100 pounds of milk contains about 0.25 to 0.35 per cent or more of fat, or about 0.30 pounds of fat, which will make about 0.35 pounds of whey butter worth about six or seven cents in the market at 20 cents a pound.

How does the skimming of whey affect the patron's monthly payment? The income from the sale of whey cream or whey butter at a large factory is usually sufficient (1) to pay the running expense of the separator including such items as fuel, oil, and depreciation; (2) to pay the cheesemaker for the extra work of handling the separator and the whey cream; and (3) to pay the patron in cash about two, three or more cents per 100 pounds of milk delivered than he would receive, if the whey was not separated. The extra payment to the cheesemaker will often enable the factory to keep a good man, who might become dissatisfied with his wages from cheesemaking alone.

How does separated whey compare with unskimmed whey as feed for hogs? Unskimmed whey contains about 7 per cent of solids, including 0.30 per cent of fat; 5 per cent milk sugar, and 1.7 per cent of albumen, mineral matter, and other solids. The fat is thus about one-twenty-third of the total solids in whey. The most careful feeding experiments have shown that the fat in feed produces about two and one-fourth times as much gain in weight in hogs, as does milk sugar or albumen, and therefore the

fat in whey makes up about a tenth[5] of the feeding value. From these figures we must conclude that separating the butter fat should reduce the feeding value of whey about one-tenth but if we compare separated whey with whey which has stood over night in the whey tank, the difference in feeding value is less than one-tenth, because during the night, a large part of the fat rises to the top, and when the patron draws or pumps the whey from the bottom of the tank into his cans, he gets only a part of this fat. Some of the floating fat is left sticking to the sides and bottom of the tank into his cans, he gets only a part of this fat. Some of the floating fat is left sticking to the sides and bottom of the empty tank, and is finally wasted in the drain, when the vat is scrubbed. Some fat also sticks to the patron's cans making them harder to clean. Factory patrons must choose between leaving part of the fat in the whey tank, cans and hog trough, or saving practically all of the fat by means of a whey separator.

Is it profitable for the farmer to sell whey cream and buy in its place corn meal, middlings, or wheat bran for feeding hogs? Generally it is. The money received by the farmer for his whey fat will usually buy a quantity of corn meal having a greater feeding value for hogs than the whey fat sold. For example, suppose a farmer delivered 4,000 pounds of milk at a factory, and from the 3,600 pounds of whey containing 0.35 per cent fat there was obtained whey cream containing 12.6 pounds of fat. The farmer received $1.20—three cents per one hundred pounds of milk delivered—as his share of the proceeds from the sale of this fat. If three pounds of corn meal are equal in feeding value to one pound of fat, the farmer may pay 38 cents for 38 pounds of corn meal for his hogs, to replace the 12.6 pounds of fat sold, and have left 82 cents as profit from skimming, or 2.05 cents per one hundred pounds of milk delivered. Although the 3,600 pounds of whey contained 12.6 pounds of fat when fresh, a part of this would have been wasted before it reached the pigs, so that they were a little better fed with the separated whey and the 38 pounds of corn meal than they would have been

[5] One experimenter has stated that the separated whey produces one-fourth to one-third less gain in weight of hogs than does unskimmed whey, but this requires further confirmation. G. E. Day, Expts. with Swine, Ont. Agr. Col. Rept. 1909, page 144. A series of pig feeding experiments with separated whey and whole whey was recently begun at the Wisconsin Agricultural Experiment Station in order to throw more light on this question.

with the unseparated whey, especially as the corn also contains some protein and yields some fertilizer for the soil, which the fat does not.

The farmer should know the weight of fat sold per one hundred pounds of milk delivered, as well as the price of corn meal in order to judge how profitable is the separation of whey. In order to satisfy patrons of their own profit from whey separation the factory man should include this figure in the monthly statement. For each pound of whey fat sold, the patrons should receive to avoid loss at least the price of three pounds of corn meal or other substitute feed.

Even at privately owned factories, it may be advisable in order to satisfy the patrons to include in the monthly statement, the weight of whey fat sold per one hundred pounds of milk delivered. Where this is not done, patrons sometimes have suspected that the cheesemaker was trying to increase his own profits at their expense. This they believed was being done by allowing more fat than usual to enter the whey, through careless methods of handling the curd immediately after cutting and in other ways, and in a few cases, patrons have refused to allow their whey to be skimmed, because of this suspicion. This, of course, could be avoided if the maker would give out definite information as to the amount of whey fat separated.

At cooperative factories, or wherever the patrons manage the selling of whey cream as well as cheese, they can tell from the factory records what proportion of the fat in the milk is being sold as whey cream. Whether this amount is large or small, the patrons get most of the proceeds, and under these circumstances there is no reason to suspect the cheesemaker or to stop skimming whey.

How much annual income may a farmer expect to receive from the separation of whey at the factory? To answer this,

		Estimate for one farm
Suppose the milk delivered in a year from one farm is....	60,000 lbs.	.....
Weight of milk divided by 400 equals approximate[1] weight of whey cream fat, 60,000 + 400=	150 lbs.	.....
Weight x price per pound = value of whey cream sold, 150 lbs. at 20c = ...	$30.00	.....
Patron receives half, the other half paying for fuel, labor, etc.....	$15.00	.....
The cooperative factory patron receives about five-eighths of the total[2].....	$18.75	....

[1] See Table III.

[2] This is a conservative method of estimating the income, and in no case is the weight of whey fat sold likely to be less than here indicated.

How is whey cream or whey butter sold? Whey cream is sold almost exclusively to creameries for churning, or in some cases for making ice cream. The cream delivered to the buyer usually brings the ruling market price or a little less for the butter fat contained. In some cases, two cents a pound less is paid for the fat in old or sour cream than for the best grade of sweet whey cream. This is done to encourage cheesemakers to cool their whey cream promptly, to keep it cold, and to deliver it frequently.

If no convenient market for whey cream can be found, it can be churned once or twice a week at the factory where the skimming was done. Thus the whey fat will be gotten into saleable form as whey butter, but under these circumstances, the churning operation itself, will usually be conducted without profit, or possibly at a slight loss.

At any factory where whey is being skimmed, whey butter can be sold readily to the patrons. At creameries or central cheese factories, where whey cream is collected and churned in large quantities, whey butter is sold also to local grocery stores, or shipped in tubs to the markets.

Under the best circumstances, the price of print whey butter to consumers at the factory, is about the same or a little less than the ruling market price obtained for creamery butter in tubs. Shipped to market in tubs, whey butter usually brings the same as, or but two or three cents less than creamery butter, the price depending on the quality of the product, and on the state of the market. When produced in a sanitary manner, whey butter is a healthful and nutritious product, though in comparison with the finest creamery butter, it is often said to be somewhat lacking in normal butter flavor.

ESTIMATING THE FACTORY INCOME FROM WHEY SEPARATION

Besides securing the approval of the patrons, and finding a satisfactory outlet or market for the whey cream, the promoter of the whey cream enterprise also should make an estimate in dollars and cents of the income, costs, and profits which under his local conditions may be expected. This can be done, as shown below, where the first column in each table contains figures for a factory averaging 5,500 pounds of milk daily through the year, and the second column is left blank to be filled by the reader

with figures representing his own factory conditions. In Table I, the average price per pound received for butter fat, less the cost of delivery to the buyer, is used. Thus, if the average price paid for butter fat was 21 cents, and if the cost of delivery[6] by auto, rail, or otherwise, was one cent a pound, the net price received for the fat was 20 cents a pound. Multiplying this price by the number of pounds of fat in the whey cream, gives approximately the value of the fat, which may be considered as a fair estimate of the gross income from this enterprise for the year.[7]

TABLE I

ESTIMATING THE INCOME FROM WHEY CREAM

	Factory averaging 5,500 lbs. milk daily	Estimate for local factory
Estimated weight of milk delivered in one year	2,000,000 lbs.	.....lbs.
Divide by 400, to get weight of butter fat in the whey cream	5,000 lbs.	.....lbs.
Average price received per lb. of fat	$.20	$.....
Multiplying, gives value of the whey cream	$1,000	$.....

COST OF EQUIPMENT FOR SKIMMING WHEY

A power separator is needed. One of the 24 factories mentioned above had previously been used as a creamery and already had a separator in place. Of the separators bought for the other factories, 16 were new, and the others were either secondhand or rebuilt. Ten were run by belt, and the rest by steam turbine. The new machines had an average capacity of 4,000 pounds per hour, ranging from 3,200 to 5,000, and cost from $300 to $500, averaging $386. The old machines averaged 3,700 pounds in capacity and $325 in cost. More than half of

[6] In Sheboygan county, in 1912, one central factory collected whey cream by auto truck from 17 other factories, and in another case whey cream was collected from five factories in a similar manner. The price paid for butter fat in whey cream, delivered by the seller, was either Elgin market quotation, or one cent less than Elgin, if the cream was collected by the buyer.

[7] Throughout this bulletin, estimates of cost are made liberally high and the costs can often be reduced below the figures given. The estimates of selling price or income are made conservatively low, as for example the selling price of fat in whey cream, which is here given as 20 cents a pound although it will often run higher than this figure, and rarely lower.

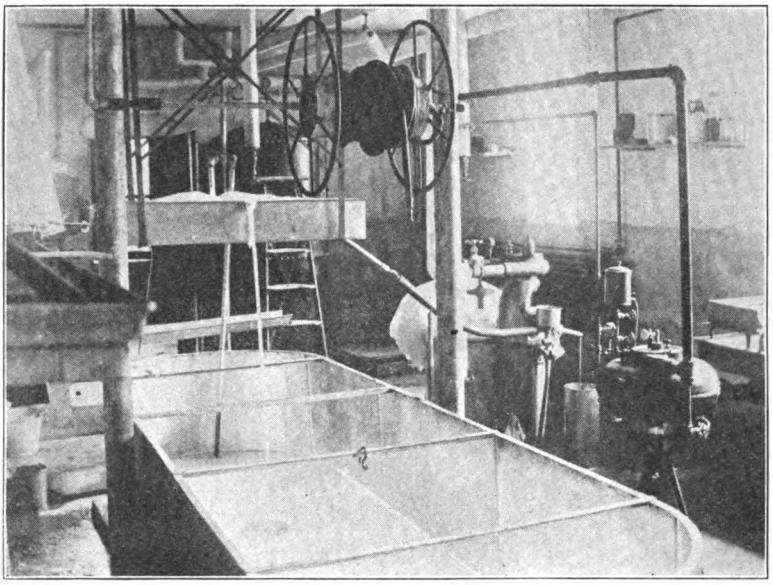

FIG. 1.—WHEY STORAGE TANK ON FLOOR

The whey runs by gravity from the cheese vat into the tank. Then it is elevated to the smaller tank which feeds the separator.

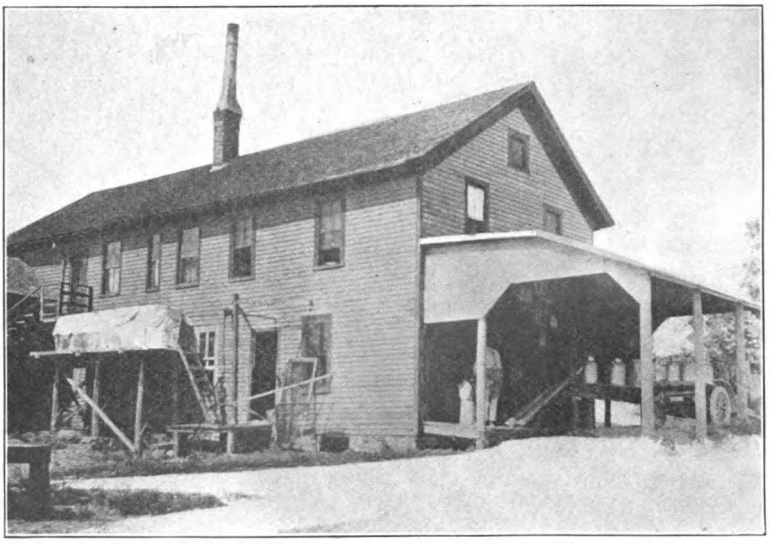

FIG. 2.—AN OUTSIDE WHEY STORAGE TANK

For lack of room inside of the factory this tank is placed out of doors on an elevated platform.

the machines were between 4,000 and 5,000 pounds capacity, and the average cost of the 24 separators was $370. New whey separators are preferred to secondhand, old style, milk separators.

A storage tank is necessary to hold the whey before it is separated. This must be large enough to use during the flush sea-

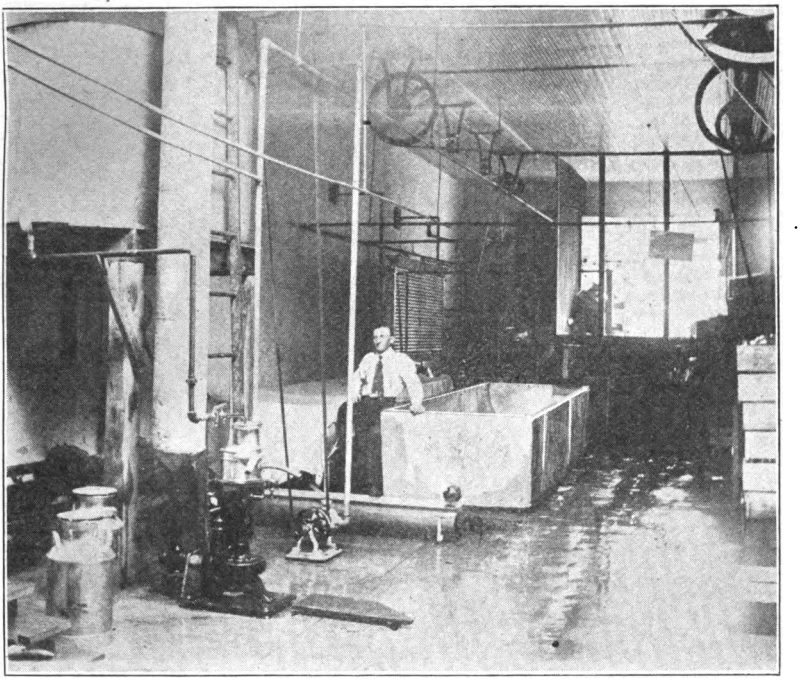

FIG. 3.—AN ELEVATED WHEY STORAGE TANK

Where space in the factory is limited, it is customary to place the tank on the second floor or on a raised platform as here shown.

son. The prices paid for storage tanks ranged from $30 to $70, averaging $47. At two factories, old cheese vats were used for this purpose. The whey vat may be placed for convenient washing, below the cheese vat, from which the whey flows by gravity into the storage tank, and is elevated later to a small tank feeding the separator; or the whey storage tank may be placed on the second floor, or on a raised platform, which may be outside the building.

In the latter case, the whey may run from the cheese vat into a tub, from which it is pumped preferably through sanitary piping into the overhead storage tank, which feeds the separator.

Pumps were used for this purpose at 20 factories, and steam jets at four factories. The pumps cost from $12 to $32, averaging $23, and the steam jets cost from $3 to $10. About half of the factories had steam engines in place which could be used to run the separators, while the other factories purchased gasoline engines costing from $135 to $250 or, in one case, an electric motor

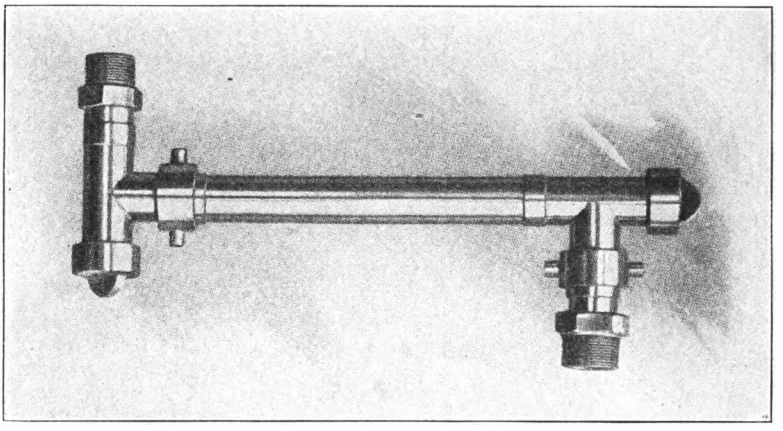

FIG. 4.—SANITARY PIPES

Pipes which can be taken apart daily for cleaning are preferable to ordinary galvanized pipes.

costing $70. Steam turbine separators can now be bought for whey separation. At one factory, additions or changes were made in the factory buildings, costing $330; at six factories the cost was $10 to $30, while at the other factories no changes in the buildings were necessary. The cost of new piping and belting was variously estimated at from $5 to $25, at the different factories. The costs of equipment at the factories described above are shown in Table II to aid the reader in estimating what it will cost to equip his own local factory for skimming whey.

It should be unnecessary to state here that in remodeling or equipping old factories for the purpose of skimming whey, no two factories are likely to be found which will require the same additions or changes throughout. No factory man should assume that his own factory can be equipped for exactly the figures given in these tables, but should carefully compare his own present equipment with the lists here given, and prepare his own estimate of the cost of making the change at his factory.

TABLE II

EQUIPMENT NEEDED FOR SKIMMING WHEY AND ESTIMATE COST

	Cost in 1912 (24 factories)			Estimate for local factory
	Minimum	Maximum	Average	
Separator, 3,000 to 5,000 pounds capacity, belt or turbine drive, new or rebuilt	$275	$500	$370	
Storage tank for whey before separating	30	70	47	
Whey pump or steam jet	3	32	23	
Alterations to building	0	330	25	
Piping, belting, and sundries	5	25	15	
Total	$313	$957	$480	
Annual interest on investment, at 5 per cent	16	48	24	
Annual charge for depreciation, at 10 per cent	32	96	48	

ANNUAL EXPENSE OF OPERATING A WHEY SKIMMING OUTFIT

The estimates of operating expense at the different factories in 1912, could not be made as accurately as those of the cost of equipment, given above, for the reason that many of these factories had been running only a few months at the time the estimates were furnished by the owners. Since the cost of power for separating depends almost entirely upon the amount of milk handled, it may be stated here that the maximum daily capacity of the 24 factories ranged from 6,000 to 15,000 pounds of milk, and averaged 9,130 pounds. Among 13 factories using steam as motive power for skimming whey, in 1912, the annual cost of coal for this purpose was estimated at from $60 to $240. At seven factories where gasoline engines were used, the annual cost of gasoline was given as from $10 to $35. The cost of running an electric motor at one factory was stated to be $50 per year. The annual cost of oil, new belts, insurance, and minor items was estimated at from $5 to $20 at different factories.

The cost of extra labor for such work as taking care of whey cream, and washing the separator, whey storage tank, and conductor pipes daily may be figured from the amount of time required, say two or three hours, at $0.25 or $0.30 an hour.

In many cases, there will be some expense for delivering whey cream to the buyer, which may be either added to the running expense, or deducted from the selling price of the whey cream, as was done in Table I.

These items are summarized in Table III, to aid the reader in estimating the annual running expense of separating whey at his own factory.

TABLE III
ESTIMATED ANNUAL RUNNING EXPENSE FOR SEPARATING WHEY CREAM

	Estimated for 5,500 lbs. daily			Estimated for local factory
	Minimum	Maximum	Average	
Coal, gasoline, or electricity.	$10	$240	$100	.....
Oil, belts, insurance, etc.....	5	20	12.50	.....
Labor, two hours daily at $0.25.....	.....	.....	182.50	.....
Freight, or expense of delivery of cream to buyer*.....	36	90*	50.00*	.....
Total	.....	.....	$295.00*	.....

* The item of expense for delivery is omitted from the total in Table III because the price received per pound of fat delivered was used in estimating the gross income, in Table I. Interest and depreciation charges are added in Table IV to the estimates given in Table III.

TABLE IV
ESTIMATED EXPENSES AND NET INCOME PER $1,000 GROSS INCOME

By subtracting from the gross income.....		$1,000	$.....
The costs and expenses,			
10 per cent annual charge for depreciation.....	$48.00	.....	.....
5 per cent annual charge for interest.....	24.00	.....	.....
Fuel, oil, insurance, etc.....	112.50	.....	.....
Labor.....	182.50	.....	.....
Total.....		$367.00	$ .....
There is left, the net proceeds.....		$633.00	$.....

This sum of money, left after paying the necessary expenses, belongs entirely to the patrons at a cooperative factory, and should be divided among them in proportion to the weight of the butter fat delivered. At a private factory, the owner can estimate from his income and expenses, as listed above, the lowest price at which he can afford to skim whey, per one hundred pounds of milk delivered, or per pound of whey fat sold, paying the rest of the income to the patrons. Or, the factory owner can determine from such figures, whether he can afford to offer the patrons two, two and one half or three cents per one hundred pounds of milk delivered, half of the gross income, or a fixed price per pound of butter fat sold in the cream, if the patrons prefer one of these methods of payment.

It will be seen in the case of the factory averaging 5,500 pounds of milk daily, used in the tables to illustrate the method of figuring, that with butter at 20 cents, the private factory owner could not afford to pay four cents, while if he paid the patrons three cents per one hundred pounds—$600 on 2,000,000 pounds of milk—he would have left, in addition to the $367 for expense as listed above, $33 as his profit on the whey cream business for the year. In this case, the whey cream separation has yielded the patrons an additional income of $600, with no additional labor on their part, and about three quarters of this sum is clear profit for cooperative factory patrons, above the hog-feeding value—$150—of the whey fat sold.

Among the private factories in Sheboygan County skimming whey in 1912, the patrons of 11 received as their whey cream payment, three cents per one hundred pounds of milk delivered; at five, two and one half cents was paid, and at another two cents. At three factories, the patrons received half of the gross income[8] from the sale of whey cream.

METHODS OF PAYING FOR THE WHEY SKIMMING EQUIPMENT

When patrons buy a separator and other equipment for skimming whey, it may be agreed that before any money is paid to the patrons the income from the sale of whey cream after paying for labor and running expenses, shall be used in paying for the skimming outfit. In this way the outfit is paid for during a part of the first year, and belongs to the factory patrons and the dealer's interest charges are stopped. At the average factory mentioned above, where the annual gross income from the sale of whey cream was $1,000, the running expenses about $25 per month, and the cost of the equipment $480, as shown in Tables I, II, and III, it will be seen that the gross income for nine average months of the first year, amounting to $750, was enough to pay for the nine months running expenses, $225; for the equipment, $480; and nine months interest on the cost of the equipment, $18, or all together $723.

If it is preferred to pay for the equipment, during a period of five years, it appears that approximately two average months' income each year will be required to cover the annual payment of principal and interest.

[8] See B. A. I. Cir. 161 already cited.

In Table III showing the annual expense for whey separation, it was assumed that the whey skimming would be continued at the factory for a period of 10 years, and 10 per cent of the original cost of the equipment paid each year, to offset the annual depreciation of the machine, in case it was sold sooner, or to replace it entirely, if necessary, at the end of that time. It should be noted that the persons who invest money in a separator with the expectation of paying for it in 10 annual payments, assume the risk of disappointment and loss of profits, in case the patrons are unable to agree afterward to continue the separation of whey for the full 10 years.

The private factory owner buying a separator will probably allow 10 per cent depreciation and 5 per cent interest on the cost of the outfit, as the annual charge for his equipment, and will deduct this and other expenses from his income from whey separation, before figuring a profit.

PAYING FOR EXTRA LABOR

At factories, where the cheesemaker pays the patrons a fixed price as two and one-half cents per one hundred pounds of milk delivered, for the privilege of skimming and selling the whey cream, the maker can readily determine as indicated in Table IV, how large his expense for labor and other items in separating should be.

At factories, where the farmers own and sell the whey cream, the maker may be paid for doing the separating at a fixed price per pound of fat sold in the whey cream. This method has the advantage of offering an inducement for the maker to skim the whey as carefully and completely as possible every day, and not to waste any whey fat. Under this system of payment, the cheesemaker receives about twice as much money for skimming 6,000 pounds of whey as he does for skimming 3,000 pounds per day. This may seem unjust because the labor of washing and setting up the separator, washing the whey storage tank, and cream cans, cooling the whey cream and keeping it cool until delivered, is nearly the same in the two cases. However, knowing the usual annual milk supply at any given factory, the maker and patrons can arrive at a fair estimate of the average daily amount of labor and time required for separating the whey, and agree upon a fair price, per pound of fat sold, to be

paid to the maker. Although the maker should receive a fair remuneration in proportion to the time and labor spent in separating, the actual payment should be made in proportion to the amount of fat sold in the whey cream, thus insuring the patrons that no whey fat shall be lost through inattention.

In the following discussion of the profits from whey separation, it is assumed that the maker is paid not less than $0.50 a day, for each day that the separator is run, even at the smallest factories.

HOW SMALL A CHEESE FACTORY CAN PROFITABLY BEGIN SKIMMING WHEY?

We have already seen that under conditions existing at 24 Sheboygan County cheese factories, the separation and sale of whey cream is unquestionably profitable if a factory handles an average of 5,500 pounds of milk daily throughout the year. A great many factories handle less milk than this, but it is not likely that the cost of equipment and the expense of separating can be reduced in proportion to the amount of milk handled at the smaller factories. Since many cheese factory patrons and managers at present are studying the question of whey separation it is desirable to estimate here as nearly as possible the income, expenses, and profits likely to be encountered at the smaller factories.

The purchase of an engine need not be considered, because the larger factories doubtless already have them, and because by use of a turbine separator and a steam jet for elevating whey, the use of an engine can be dispensed with. Various economies can often be practiced which will reduce the cost of equipment. For example, at small factories a discarded cheese vat often can be used as a whey storage tank.

Since small power separators cost more in proportion to capacity than the larger ones, the cost of a separator becomes of greater importance at the smaller factories. In some cases, second-hand separators may be bought cheaply, but unless they are guaranteed and are found on trial to work smoothly and to skim efficiently, new separators may be more economical.

The annual charges for depreciation and interest and insurance depend entirely on the cost of the equipment. The charge for labor can hardly be reduced below $0.50 each day that the whey is separated, nor is it desirable to do so. On the contrary,

the additional wages of $15 a month or $180 a year for running the separator, added to the $50 a month or $600 a year, which is about all many small factories can afford to pay for cheesemaking alone, will in addition to yielding the patrons a profit on the whey fat, often enable the factory to secure and retain the services of a more experienced and capable cheesemaker. From this point of view, whey skimming is especially desirable in the small cheese factory.

To keep down running expenses within the necessary limits good management is necessary, especially in the smaller factories. The difference which a few cents in the selling price of whey cream, or a few dollars in the amount of money invested in equipment or fuel, will make in the profits at the end of the year should not be overlooked. Before any money is spent for equipment for skimming, the persons most interested should carefully calculate the probable gross income, the running expense, and the net income according to the method illustrated in this bulletin. From such estimates, conservatively made, it can be seen how much money may be spent safely for equipment, for labor, and for annual running expenses. The figures given in the tables will help the reader to make accurate estimates to fit the conditions at any American factory, where it is planned to begin skimming whey.

Patrons must expect less profit from the skimming of whey at small than at larger factories. At the bottof of Table V, it is seen that the patron's net proceeds from skimming whey are 3.2 cents per 100 pounds of milk at the largest factory, but only 1.1 cents at the smallest. With corn meal at $20 per ton, any amount of money over one cent per 100 pounds of milk delivered, or three cents per pound of fat skimmed from the whey, received from the sale of whey cream may be considered as profit to the farmer. Many of the smallest factories may find whey skimming profitable.

The patron can tell with certainty how much profit he is making from whey separation only by knowing the weight of whey fat skimmed per 100 pounds of milk and also the cost of buying corn or other feed in sufficient quantities to replace the separated fat for hog feeding.

TABLE V
COST AND PROFIT IN SKIMMING WHEY AT LARGE AND SMALL FACTORIES

						Estimate for local factory
Factory running months	12	12	12	8	6	
Milk per day, lbs	9,000	4,500	2,250	2,250	2,000	
Equipment total cost	$685	$607	$411	$381	$269	
Capacity of whey separators	5,000	5,000	3,500	3,500	1,200	
Cost new	$500	$500	$350	$350	$200	
Whey storage tank, size gals	2,100	1,000	500	500	.....	
Cost new	$45	$32	$17	$17	.....	.....
Whey pump or steam jet	$25	$10	$4	$4	$4	
Piping sundries	$15	$15	$15	$10	$5	
Building alterations	$100	$59	$25	.....	.....	
Annual charges, total	$578	$328	$272	$200	$141	
Depreciation, 10%	$69	$60	$41	$38	$21	
Interest 5%	$34	$30	$21	$19	$10	
Coal, gasoline, electricity	$100	$50	$25	$18	$15	
Oil, insurance, etc	$15	$8	$5	$5	$5	
Labor	$360	$180	$180	$120	$90	
Gross income:						
Milk handled annually, lbs	3,285*	1,642*	821,250	547,500	365,000	
Fat sold in whey cream, lbs	8,210	4,106	2,053	1,370	913	
Value at 20c lb	$1,642	$821	$411	$274	$183	
Deduct expense	578	328	272	200	141	
Net proceeds, total	$1,064	$493	$139	$74	$42	
Per pound of fat separated, cts.	12.9	12.0	6.8	5.4	4.6	
Per 100 pounds milk, cents	3.2	3.0	1.7	1.3	1.1	

*Last three figures omitted.

CARE OF WHEY CREAM

Although whey butter as a rule may be somewhat lacking in that fine flavor, which characterizes the best creamery butter, yet there is no doubt that a perfectly sweet, clean product, which is wholesome, and entirely fit for food, can be made if the milk supply and whey cream are properly handled. Well-made whey butter commonly will be found entirely satisfactory to the patrons, who will use up most of the product, in view of the fact that it is better in quality and more uniform and also somewhat cheaper in price than much of the butter sold in small towns.

At any cheese factory where the patrons have learned how to take care of milk properly for cheesemaking purposes, it should be possible to make good whey butter. Taking care of the milk properly on the farm means, among other things, that the cows are kept healthy, well fed, and clean, that they are not fed dusty feed just before milking, that the milk pail has a closed top, that the milker's hands and the cow's udder, and the premises generally are clean and well taken care of, and the barn well ventilated and lighted. The milk from each cow should be

weighed and removed at once from the barn to a room free from dust and bad odors, where it should be strained through a metal and clean cloth strainer and cooled as quickly as possible to about 55° or lower. The cooling is best done by setting the cans of milk in a covered tank of cold well water (which is usually placed between the windmill and the watering tank). The milk should be stirred frequently, until cool. It should then be kept cool and covered until delivered at the cheese factory.

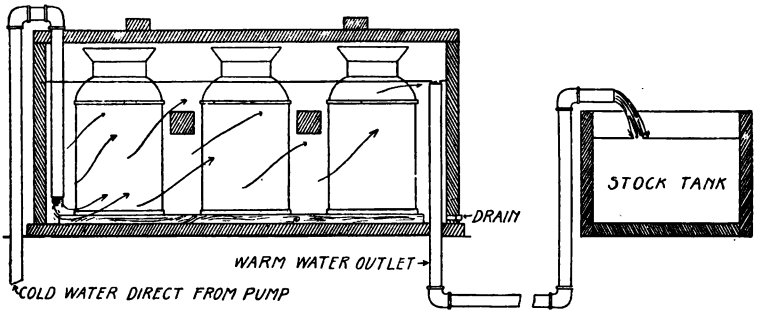

FIG. 5.—VAT FOR COOLING WHEY CREAM

All the well water pumped at the factory flows first through a pipe which enters this tank near the bottom. The overflow pipe supplies water for factory use or for watering stock on the farm. After Frandsen.

As soon as the whey is drawn from the vat, in the process of cheesemaking, the separator may be started. The cream screw should be adjusted to deliver cream containing from 50 to 75 per cent of fat, so as to permit the use of a large proportion of starter in churning. The separator should be taken apart and washed every time it is used. The separating process usually requires one or two hours for completion, and should be begun as early as possible, while the whey is yet warm. The drippings from the vat may be allowed to run into the whey storage tank as long as the separator is running, or may be cooled and saved for separation next day, but drippings from the press will affect the flavor of the product and should not be run through the separator.

The whey cream, in a tall, narrow can, is immediately set for cooling in a vat of cold water and stirred frequently, changing the water two or three times so as to cool the cream as quickly as possible. Whey cream, once cooled to the temperature of well water, should be kept cold until churned. It is not sufficient to cool a can of cream, and afterward set it in a curing room or cel-

lar at about 60 or 70 degrees F. It should be kept standing in a vat of well water at 50 degrees F. or lower or set in a room cooled with ice, if possible. Where this is done, cream can be kept in good condition and churned every third day[9] with entire success, as is now being done at some of the best factories producing whey butter.

Generally, the same kind of milk can storage tank may be used at the factory for cooling and storing whey cream as that used at the farm for cooling milk and keeping it cold over night. In this way the cooling vat and methods used at the factory may serve as a model for the farmer.

The evening before the whey cream is to be churned, about 75 or 100 per cent of a good, thick, cold starter may be stirred into the cream, and if necessary, pure ice may be cracked fine and added to cool the cream so that it will be at 50 degrees F. or a little below, when churned the next day.

The churn is first scalded, and then rinsed with cold water to cool it. The cream is churned until the butter is in small granules, when the churn is stopped. The butter can be washed more thoroughly, and the salt worked in more easily and quickly, while the butter granules are small. The wash water should be quite cold—(about 40 to 50 degrees)—for the additional reason that whey butter has a greater tendency than ordinary butter to soften on warming, and unless well cooled it may be difficult to print. The packed butter should be kept in the cooler until sold.

Whey cream which is to be sold instead of churned should be cooled at once after separating and kept cold until delivered. Buyers of whey cream for churning often pasteurize it when received, by heating it rapidly nearly to boiling, then cooling as quickly as possible, adding starter, and churning the next day.

WHETHER TO SELL OR CHURN WHEY CREAM?

At the majority of cheese factories, the amount of whey cream produced daily is not sufficient for a churning, and the cheese-

[9] Where whey cream is being collected from a number of factories for churning at one central plant, lack of proper care in handling it at any one factory may often lower the quality of the entire churning of whey butter. On this account, it is recommended that it be delivered four times a week, or every other day, if daily delivery is impracticable.

makers prefer to sell whey cream rather than to churn it, for the same reasons that lead the majority of farmers to sell hand separator cream rather than to churn it at home. These reasons are (1) that the factory at which the cream is delivered, is usually better equipped for the butter business, as to appliances, labor, skill, and marketing facilities, than the small producer and (2) that the profits from churning are attractive only when a sufficiently large supply of cream is available.

As stated on an earlier page, the return from the whey fat can be doubled by running the whey through the separator and selling the whey cream at the market price based on the price of butter fat. While from 16 to 20 per cent greater return is obtained by churning in order to secure the overrun, the cost of labor, refrigeration, and equipment for churning on the larger scale may be greater than the cost of whey separation. The separation may be successfully accomplished at any cheese factory but an ice supply is needed if churning is done.

INCOME AND EXPENSE IN CHURNING

The expense connected with the churning of whey cream consists of the annual charge for interest and depreciation to repay the investment in the equipment, and the cost of labor, and of supplies, such as color, salt, wrappers, tubs, cartons, fuel, ice, and for repairs and insurance.

Among cheese factories in Sheboygan County churning whey cream in 1912, one bought a new combined churn costing $215, and four bought new combined churns capable of handling about 200 pounds of butter at from $85 to $90 each. A starter can costing $75, and a ripener at $225 were bought for the largest factory, first mentioned, while the others used appliances already at hand. One factory erected a new ice house and refrigerator at a cost of over $700, while the others were already suitably provided with ice supply, so as to avoid further expense. The cost of butter printers varied from $8 to $25. A cream scale cost about $25. One factory undertaking the churning of whey cream was already equipped as a creamery, having been used formerly for this purpose. Omitting the cost of icehouses, the total cost of equipment for churning was $575 at the largest factory, and varied from $108 to $130 at the other four, averaging $122.

If it be assumed that the cost of the buttermaking equipment

is $125, that the average price of butter fat per pound is 24 cents, that the overrun is one-sixth, and that the outfit will last in continuous use for 10 years, then the annual charge of $37.50 (15 per cent of investment) for interest and depreciation may be met by the overrun at four cents per pound on 950 pounds of whey fat, or about nineteen 60-pound tubs of butter.

The charge for labor for three hours at 25 cents per hour, on two, three, or seven days per week would amount to $1.50, $2.25, or $5.25 per week, which would amount in a year to $78, $117, or $270, thus consuming the income from overrun on 33, 50, or 113 tubs of butter, or more.

The cost of fuel for operating the churn; pasteurizing the cream, if this is done; and pumping water for cooling, is difficult to estimate, but may vary from $25 to $100 per year. The cost of supplies, including tubs, salt and wrappers was estimated at $10 to $20 per year, ice at $35 to $75 per year, and repairs, oil, insurance, and sundries at $25.

The estimates of annual expense for churning at four factories of from 8,000 to 15,000 pounds capacity (flush) handling only their own whey cream, varied from $90 to $145, not including labor. At two factories buying whey cream for churning, in addition to their own, and paying from $30 to $50 a month for a helper who also served as buttermaker, the annual expense beside labor was estimated at $211 to $391.

To calculate in advance what the annual expense would be for churning whey cream at any factory where it is planned to install a churning outfit, the total cost of the churning outfit listed above is assumed as $————. Of this sum 15 per cent is the annual allowance for interest and depreciation to be paid from the earnings.

Interest and depreciation	$.....
Labor	.....
Fuel	.....
Supplies	.....
Repairs	.....
Total annual expense	$.....
Weekly expense	$.....

Comparison of this weekly expense with the weekly income from overrun as indicated in Table VI, will show whether the churning, as planned, will be profitable or not.

To estimate approximately the income from overrun in churning whey butter at the factory, it is only necessary to make the following simply calculation based on the amount of milk handled:

Amount of milk ....lbs.
Whey fat = milk + 400 ....lbs.
Overrun = fat + 6 ....lbs.
Gross income from churning = overrun × price of butter..... $.....

Table VI shows the estimated income from churning at factories of different sizes, and the limits within which the annual expenses must be kept if the churning is to be profitable.

TABLE VI

AVERAGE DAILY MILK SUPPLY AT THE FACTORY

	For 12 months in the year			For 8 mos.	For 6 mos.
	9,000 lbs.	4,500 lbs.	2,250 lbs.	2,250 lbs.	2,000 lbs.
Whey fat sold yearly, lbs....	8,100	4,050	2,025	1,350	900
Weight of overrun, lbs.....	1,350	675	333	225	150
Value of overrun at $0.25, dollars.....	337.50	169.00	85.00	56.00	38.00
Income per week, dollars....	6.49	3.25	1.63	1.65	1.44

From this table it can be seen that the income from overrun at the three smaller factories would probably not pay a fair price for the labor of churning twice a week, and other running expenses. At the largest factory listed, the income per week might pay for the labor of churning and part of the running expenses. At these factories churning should be undertaken only through necessity or choice, not for profit. It is readily seen however, that if whey cream can be collected for churning from several neighboring factories, handling altogether 18,000, 36,000, or 72,000 pounds of milk daily, then the weekly income from churn overrun becomes $13, $26, or $52, and may easily yield the buttermaker a profit. In general, however, unless the cheesemaker has had experience also as a buttermaker, and is prepared to make churning an important part of his work, he will prefer to sell his whey cream in the nearest market, rather than undertake to churn it himself.